North Coast Watershed Assessment Program

DRAFT

Redwood Creek Watershed Synthesis Report

The mission of the North Coast Watershed Assessment Program is to conserve and improve California's north coast anadromous salmonid populations by conducting, in cooperation with public and private landowners, systematic multi-scale assessments of watershed conditions to determine factors affecting salmonid production and recommend measures for watershed improvements.

Public Review Draft

NCWAP General Findings and Discussion

Redwood Creek Basin Issue and Recommendations Synthesis

While a number of impairments to salmonid habitat exist in the Redwood Creek watershed, recent studies have shown that parts of the upper one third of watershed is producing significant quantities of juvenile chinook salmon. Identified impairments include high instream sediment levels, stream channel aggradation and widening (level of the streambed rises and widens due to deposition of sediment and eroding streambanks), lack of stream habitat structure such as deep pools, stream water temperatures that are too high to support salmon, loss of functioning estuary habitat due to levee construction and excessive sediment accumulations. Human activities—such as road construction, grazing of livestock, timber management, and levee construction—have interacted with natural geologic instability and sediment production, and major rainstorm events (e.g., the 1964 flood) to contribute to these salmon habitat impacts. Limited water column chemistry monitoring in Redwood Creek generally indicates no problems with nutrients, dissolved oxygen, phosphorous, and nitrogen.

Watershed problem sources on the Redwood Creek watershed are located more on the middle and upper portions of the watershed, where steeper slopes, higher geologic instability, higher road densities, and more intensive land uses are found. Impacts of these upper watershed effects, sedimentation in particular, tend to concentrate in the mainstem and lower reaches of the watershed due to cumulative effects and lower stream gradient. One particularly complex salmonid habitat suitability issue—stream water temperature—needs additional analysis in light of the multifaceted interrelationships between stream water temperature and factors such as air temperature, streamside vegetation, channel width, groundwater influences, and basin size.

In general, there is a notable difference in stream habitat between the mainstem Redwood Creek its tributaries. The fundamental differences are related to the smaller size, higher gradient, and confined channel of the tributaries, particularly as compared to the low gradient, unconfined channel of the lower reach and most of the middle reach of mainstem Redwood Creek.

The sections below summarize specific conclusions and recommendations for the five Redwood Creek subbasins (estuary, Prairie Creek, lower Redwood, middle Redwood, and upper Redwood) that we delineated on the basis of geography, geology, climate, land use, and hydrology.

Estuary

The Redwood Creek estuary provides an important transition between marine and freshwater environments. Because of their high productivity and isolation from predators, estuaries provide a very productive environment for fish. Sediment supply to the estuary is naturally high due to its position the mouth of Redwood Creek.

Key Findings:

- Naturally high erosion rates, major storms, upstream human-caused disturbances, and levee construction in the estuary have exacerbated sediment accumulation in the estuary and reduced the quantity and quality of habitat for salmon.

- Water temperatures in the estuary have exceeded the "fully suitable" range for salmonids since at least 1997, when monitoring began.

Key Recommendations:

- Improvements to estuary conditions for salmon should be made through activities both within the estuary and upstream.

- Within the estuary, opportunities should be explored for levee modifications that would improve flow conditions, drainage patterns, and increase estuarine habitat area and increase the function of adjacent wetlands and sloughs.

- Upstream actions that could benefit the estuary are discussed in more detail in the sections for those subbasins. In general, activities that reduce sediment generation and transport and that help to lower water temperatures will benefit salmon habitat conditions in the estuary.

Prairie Creek Subbasin

The Prairie Creek watershed is largely under management by the Redwood National and State Parks (RNSP) today. While there has been some timber harvesting in the subbasin in the past (including the construction of extensive landings built in or along the stream channel), portions of the land in this watershed are relatively undisturbed and retain old growth forest characteristics

The Prairie Creek watershed offers some of the most pristine or refugia type fisheries habitat within the coastal redwood region. Prairie Creek and its eight major tributary streams support populations of chinook salmon, coho salmon, steelhead, and coastal cutthroat trout, and it produces the most coho salmon in the Redwood Creek basin.

Key Findings:

- Based on NCWAP's use of the EMDS model for watershed evaluation, and other information, the Prairie Creek subbasin provides the best salmonid habitat of any of the Redwood Creek subbasins.

- With its coastal fog belt position and dense streamside canopy from mature vegetation, stream water temperatures are fully suitable for salmonids.

- Intensive fine and suspended sediment problems arose in this subbasin during and after the construction of the Highway 101 bypass in 1988-90. Studies indicated that impacts to salmonid habitat occurred as a result and that the habitat may not yet be fully recovered.

- Additionally with respect to roads and their sediment generation potential, our EMDS analysis indicted that the density of roads on potentially unstable slopes and the number of road/stream crossings were at a somewhat high level in the Lost Man Creek planning watershed area of the subbasin.

Key Recommendations:

- Given the high quality salmonid habitat conditions on the Prairie Creek subbasin, we recommend that this habitat be protected from degradation. Since the majority of the subbasin is in parkland, this goal should be readily achievable.

- Given the problems with the Highway 101 bypass, we recommend that CALTRANS carefully monitor sediment delivery from this road and take steps to eliminate or absolutely minimize the generation and transport of sediment from this site.

- Because of the concerns the EMDS model raised about roads in the Lost Man Creek planning watershed, we recommend that a closer look be taken at roads in this area and that any needed improvements that are identified be made. Road surveys already completed in the area by RNSP and the Redwood Creek Landowners Association may help to identify these needs.

Lower Redwood Creek Subbasin

The lower Redwood Creek subbasin extends from the confluence of Redwood and Prairie Creeks to near the upper boundary of the Redwood National and State Park (RNSP). Essentially the entire subbasin is managed by RNSP. Lower Redwood Creek subbasin supports populations of chinook salmon, coho salmon, steelhead, and coast cutthroat.

While now under park protection, significant amounts of timber were harvested in this subbasin, particularly in the period just before the park was expanded in the late 1970s and, to a lesser extent, during the period from 1954-1962. Aerial photo analysis indicated particularly large clearcut units during this earlier phase of harvest. Extensive ground disturbance resulted from this harvesting, including numerous skid trails constructed on steep slopes.

Key Findings:

- There is an abundance of debris slides along the mainstem channel in this subbasin. These may be due to a zone of weak, sheared rock close to the Grogan fault, which runs through this part of the watershed. Elevated groundwater levels resulting from extensive timber harvests before the park area was expanded in 1978 may also be a driving factor.

- Sediment deposition in lower Redwood Creek has lead to aggradation and channel widening, thus contributing to a reduction in stream flow. Sediment from sources in the middle and upper subbasins tend to accumulate here due to the lower stream gradient and unconfined channel in the lower portion of the Redwood Creek mainstem.

- Within the lower subbasin, the EMDS model indicates that roads on potentially unstable slopes may be a problem sediment source in Devil's Creek, Bond Creek, and McArthur Creek planning watersheds.

- Stream water temperatures in the mainstem lower Redwood Creek are generally above those that are fully suitable for salmonids, ranging from MWATs of 60° F (just meeting the "fully suitable" criterion used by NCWAP) at the confluence of Bridge Creek to 70° F ("fully unsuitable") at the confluence of Tom McDonald Creek, then dropping to 67° F ("moderately unsuitable") just below Prairie Creek.

- Historic timber harvest has reduced canopy closure in streamside areas and likely contributed to elevated stream temperatures.

- Based on conditions in the lower Redwood Creek subbasin, we found that habitat conditions here are unfavorable for salmonids due to high levels of sediment, high stream water temperatures, and poor aquatic habitat structure due to a lack of pools. The lack of pools appears to be the result of high sediment levels and a lack of large woody debris.

Key Recommendations:

- Given the elevated sediment levels, we recommend that RNSP and landowners continue their work to survey roads for problems, decommission unneeded roads, and repair identified road problems that contribute to sediment generation and delivery, both within the lower subbasin and in the middle and upper subbasins.

- For timber management on steep slopes we recommend (for the middle and upper basins, since the lower basin is essentially all in park land) the use of lower impact silvicultural prescriptions and the use of cable or helicopter yarding to reduce the potential for sediment production.

- Ensure that adequate streamside protection zones are used to reduce solar radiation and to moderate air temperatures in order to reduce heat inputs to Redwood Creek and its tributaries.

- Where current streamside canopy is inadequate and site conditions are appropriate, use tree planting and other vegetation management techniques to hasten the development of denser and more extensive riparian canopy.

- To address the lack of large woody debris, we encourage recruitment of large woody debris through allowing streamside conifers to grow to large sizes and through direct placement of large woody debris. Land managers should consider cautious thinning from below in riparian areas to hasten the development of large riparian conifers.

Middle Redwood Creek Subbasin

Middle Redwood Creek subbasin includes the area above the confluence of Redwood/Devil's Creeks excluding Devil's Creek up to the confluence of Redwood and Lupton Creeks. There are fundamental differences between the mainstem and tributaries related to the generally smaller size, higher gradient, and confined channels of the tributaries. The Middle Redwood Creek subbasin supports populations of chinook salmon, steelhead, and coast cutthroat. Coho salmon were noted as present in Karen Creek (Brown 1988), but none was observed during 2001 surveys.

The middle portion of Redwood Creek closely follows the Grogan fault zone from Highway 299 to Beaver Creek. The channel widens significantly immediately below the mouth of Minor Creek within this long, relatively straight reach. In the wider reach, stream bars and terraces are more abundant and voluminous than upstream. Sediment storage predominates here; streamside slides are less frequent. The high amount of stored sediment may be related to a large, long-term input of sediment from the Minor Creek drainage. Large "earth flow amphitheaters" are common along the eastern part of the watershed beginning at Coyote Creek and dominate the topography of this part of the basin. They typically contain active earth flow complexes.

The dominant vegetation in the middle subbasin is forestland, plus a significant amount of grassland. There is a long history of timber harvest in the subbasin, with a sharp peak in acres harvested in the 1980s, when about half of the forested area was harvested.

Key Findings:

- In-channel sediment sampling with McNeil samplers found fine sediments exceeding TMDL targets in a number of locations. This abundance of fine sediment threatens salmonid fry emergence.

- As indicated by the EMDS model, roads, as a potential sediment source, are consistently problematic in all eight planning watersheds in the subbasin, due to many stream crossings, high road density on lower hill slopes and on potentially unstable areas, and road proximity to streams.

- Middle Redwood Creek mainstem stream habitat conditions are unfavorable for supporting salmonids due to high levels of sediment deposition.

- Middle Redwood Creek is the most intensely monitored area of the watershed and temperature data have been collected in this subbasin since 1996. Tributaries are borderline or exceed the "fully suitable" range, while the mainstem approaches the lethal limit of 75° F. Salmonid habitat may be threatened by temperature in this subbasin by lack of streamside trees, which function to create a cooling microclimate, perhaps a wide channel, and is influenced only slightly by cold water from tributaries to the mainstem.

- As indicated by the EMDS model, levels of streamside canopy and size of streamside trees in the middle basin may be limiting the stream shading and recruitment of large woody debris recruitment into the Redwood Creek system.

- Mainstem Redwood Creek and its tributaries in the middle Redwood Creek subbasin are hindered by the lack of complex pools including a large woody debris component, riparian cover of adequate size, lack of pool depth in the tributaries, and high embededdness in mainstem.

Key Recommendations:

- We recommend the upgrade or decommissioning of roads located in all eight planning watersheds in accordance with existing or future road assessment surveys, especially roads located on unstable slopes and roads near streams. If new roads need to be constructed, they should not be located near the valley bottom where they may pose a high risk of generating sediment delivery to streams.

- For timber management on steep slopes we recommend the use of lower impact silvicultural prescriptions and the use of cable or helicopter yarding to reduce the potential for sediment production.

- Ensure that adequate streamside protection zones are used to reduce solar radiation and to moderate air temperatures in order to reduce heat inputs to Redwood Creek and its tributaries.

- Where current streamside canopy is inadequate and site conditions are appropriate, use tree planting and other vegetation management techniques to hasten the development of denser and more extensive riparian canopy.

- To address the lack of large woody debris, we encourage recruitment of large woody debris through allowing streamside conifers to grow to large sizes and through direct placement of large woody debris. Land managers should consider cautious thinning from below in riparian areas to hasten the development of large riparian conifers.

Upper Redwood Creek Subbasin

The upper Redwood Creek subbasin encompasses all the area upstream of the confluence of Lupton Creek. This subbasin has the highest relief, greatest proportion of natural prairies and the highest percentage of private ownership. The upper Redwood Creek subbasin supports populations of chinook salmon, steelhead, and coastal cutthroat.

The upper main stem of Redwood Creek lies within a narrow channel that follows the trace of the Grogan Fault zone. Abundant streamside landslides flank the narrow main stem channel, or inner gorge. These slides appear to have delivered sediment directly into the creek. The storm and flood of 1964 caused massive debris jams and sediment accumulations in the main channel. Aerial photos from 1965 show the mainstem significantly widened and choked with active sediment. The debris jams and sediment have moved down the watershed over time by ensuing smaller storm events. The upper basin is a major contributor of sediment moving down the mainstem.

Like most of the other Redwood Creek subbasins, the upper subbasin is dominated by forest. However, it has relatively more hardwoods and grasslands than any of the other subbasins. The vegetation types here are indicative of a drier, warmer climate than the lower portions of the watershed. The subbasin has a history of timber harvest. Harvest peaked in the 1980s with 78 percent of the subbasin being harvested in that decade.

The Redwood Creek Landowners Association has trapped and monitored the downstream movement of fish in the upper basin, using a rotary screw trap on the mainstem approximately four miles downstream from Minor Creek. In 2000, there was a total of 123,633 juvenile chinook, 12,263 age 1+ steelhead, and 736 age 2+ steelhead trapped. These numbers expanded with trapping efficiency data resulted in a population estimate of 427,542 ± 37,446 juvenile chinook, 68,329 ± 9,273 age 1+ and 4,739 ± 1,070 age 2+ steelhead. In 2001, a total 120,692 chinook and 21 1+ chinook were trapped and the population estimate was 378,000. No coho were observed during either year. These data indicate that spawning conditions in portions of the upper third of the basin are suitable for chinook salmon and the watershed is supporting fry as well. The trapping studies also indicate juvenile steelhead are utilizing the upper third of the basin.

Key Findings:

- Mainstem temperatures are coolest in this subbasin possibly due to cold water inputs from tributaries and the presence of large trees bordering a narrow incised channel. However, MWATs for the mainstem exceed the "fully suitable" range for salmonid production with MWATs of 65° F at Minon Creek and 71° F at the O'Kane gauging station. However, tributaries in the upper watershed exhibit MWATs of 54-65F.

- Upper Redwood Creek stream habitat conditions are favorable for supporting salmonids due, in part, to recovery from past channel aggradation.

- As indicated by the EMDS model, levels of streamside canopy and size of streamside trees in the upper basin may be limiting the stream shading and recruitment of large woody debris recruitment into the Redwood Creek system.

- As indicated by the EMDS model, roads, as a potential sediment source, are consistently problematic in all six planning watersheds in the subbasin, due to many stream crossings, high road density on lower hill slopes and on potentially unstable areas, and road proximity to streams.

- The upper Redwood Creek subbasin exports sediments that contribute to aggradation and persistent impairment of salmonid habitat in the lower Redwood and estuary subbasins.

Key Recommendations:

- We recommend the upgrade or decommission of roads located in all eight planning watersheds in accordance with existing or future road assessment surveys, especially roads located on unstable slopes near streams. If new roads need to be constructed, they should not be located near the valley bottom where they may pose a high risk of generating sediment delivery to streams.

- For timber management on steep slopes we recommend the use of lower impact silvicultural prescriptions and the use of cable or helicopter yarding to reduce the potential for sediment production.

- Ensure that adequate streamside protection zones are used to reduce solar radiation and to moderate air temperatures in order to reduce heat inputs to Redwood Creek and its tributaries.

- Where current streamside canopy is inadequate and site conditions are appropriate, use tree planting and other vegetation management techniques to hasten the development of denser and more extensive riparian canopy.

- To address the lack of large woody debris, we encourage recruitment of large woody debris through allowing streamside conifers to grow to large sizes and through direct placement of large woody debris. Land managers should consider cautious thinning from below in riparian areas to hasten the development of large riparian conifers.